内部磁気圏におけるホイッスラーモード・コーラス放射の飽和機構

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Saturation mechanisms of whistler-mode chorus emissions in the inner magnetosphere

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Recent particle simulation studies[1,2] reveals that seeds of whistler-mode chorus emissions are generated as the results of the absolute instability of the nonlinear wave growth near the equator. The nonlinear wave growth is due to formationof an electromagnetic electron hole in the velocity phase space. The rising tone of chorus emissions is a key element to realize the nonlinear wave growth at the equator where the inhomogeneity of the magnetic field is negligible. The frequency sweep rate is proportional to the wave amplitude, while the gain of the absolute instability is relatively small because of the balance between the nonlinear growth term and the convection term of the wave amplitude equation. The absolute instability at the equator is saturated because of filling of the electron hole due to entrapping of resonant electrons by the chorus wave packet propagating away from the equator. The chorus wave packet grows in space due to the convective instability driven by the electron hole. As the packet moves away from the equator, the resonance velocity increases while the parallel velocities of the resonant electrons decreases due to the adiabatic motion in the inhomogeneous dipole magnetic field. The adiabatic variation of the energetic electrons results in saturation of the nonlinear convective instability. Starting from the optimum wave amplitude for triggering the rising tone emission[3], we evaluate the maximum wave amplitude attainable through both absolute and convective instabilities of the nonlinear wave growth of chorus wave packets for various parameters in the inner magnetosphere.

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